

Claims

1. A switchable optical unit (1; 50; 200) capable of controlling a beam of radiation (b) passing through an optically active portion (8; 108) of the unit, which unit comprises a chamber (10; 110) and an electrically conductive liquid (18; 118; 218) contained in the chamber and having an index of refraction different from that of its surroundings, the chamber being provided with an electrode configuration (20,22,24,28; 120,122,124,128; 220,222) wherein application of a voltage (V), from a voltage control system (30,32,34,36,38,40,41,42; 130,132,134,136,138,140,141,142) to electrodes causes movement of the said liquid, characterized in that the electrode configuration comprises a pair of first, central, electrodes (20,22; 120,122; 220,222) fixed to the inner walls (12,14) of the chamber at the position of the optically active portion (8;108), second electrode means (24;124) fixed to the inner walls of the chamber at positions outside the optically active portion and a third electrode (28;128) in contact with the conductive liquid and continuously connected to a first output (32; 132) of a voltage source (30; 130), a second output (34; 134) of which is connected in a first mode to at least one of the first electrodes and in a second mode to the second electrode means.
2. A switchable optical unit as claimed in claim 1, characterized in that the second electrode means (24; 124) is constituted by one annular electrode having a U-shaped cross-section.
3. A switchable optical unit as claimed in claim 1 or 2, characterized in that the interior wall (12,14) of the chamber facing the liquid is coated with an insulating hydrophobic layer (44; 144).

4. A switchable optical unit as claimed in claim 1, 2 or 3, characterized in that the chamber comprises a medium (19; 119; 219) which has an index of refraction different from that of the conductive liquid (18; 118; 219).
5. 5. A switchable optical unit as claimed in claim 4, characterized in that the medium (19; 119; 219) is a liquid.
6. A switchable optical unit as claimed in claim 4, characterized in that the medium (19; 119; 229) is a gas.
10. 7. A switchable optical unit as claimed in claim 1, 2 or 3, characterized in that the liquid-less portion of the chamber (10; 110; 210) is at vacuum.
15. 8. A switchable optical unit as claimed in any one of claims 1-7, comprising at least one lens element (2, 4) characterized in that at least one chamber wall (12, 14) situated in the optically active portion (8) is constituted by a refractive lens surface.
20. 9. A switchable optical unit as claimed in claim 8, characterized in that each of two opposite chamber walls (12, 14) situated in the optically active portion (8) is constituted by a refractive lens surface.
25. 10. A switchable optical unit as claimed in claim 8 or 9, characterized in that at least one of the refractive lens surfaces (12, 14, 46, 48) is an aspherical surface.
11. A switchable optical unit as claimed in any one of claims 1-10, characterized in that at least one chamber wall (56; 78) situated in the optical active portion (108) is provided with a phase structure (58, 60; 202).

12. A switchable optical unit as claimed in claim 11, characterized in that the phase structure is a non-periodical structure (202), which renders the unit to a wavefront-modifying unit.
- 5 13. A switchable optical unit as claimed in claim 11, characterized in that the phase structure is a periodical structure (58,60).
- 10 14. A switchable optical unit as claimed in any one of claims 1-13, characterized in that the voltage control system (30,32,34,36,38,40,41,42; 32,134,136,138,140,141,142) is arranged to supply a voltage to the first electrodes (20,22; 120,122; 220,222) individually.
- 15 15. A switchable optical unit as claimed in any one of claims 1-14, characterized in that the index of refraction of the electrically conductive liquid (18; 118; 218) is equal to that of the optically relevant material of the chamber wall (12,14; 112,114).
- 20 16. An optical camera (300) including a controllable lens system, characterized in that the lens system (1; 302) comprises a switchable optical unit as claimed in any one of claims 1-10.
- 25 17. A hand-held apparatus including an optical camera (300) as claimed in claim 16.
- 30 18. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364, 374), an objective system (370) for focusing the scanning beam (374) to a scanning spot (380) in the information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the information layer in electrical signals, the radiation source being switchable to emit a read beam and a write beam respectively, characterized in that it comprises a

diffraction element (392) for both the read beam and the write beam in the form of a switchable grating unit (50) as claimed in claim 13.

19. An optical head (360) for scanning an information layer (354) and
5 comprising a radiation source unit (362) for supplying a scanning beam
(364,374) an objective system (370) for focusing the scanning beam (374) to a
scanning spot (380) in the information layer (354) and a radiation-sensitive
detection unit (384) for converting scanning beam radiation (390) from the
information layer in electrical signals, the radiation source being switchable to
10 emit a read beam and a write beam respectively, characterized in that it
comprises a diffraction element (392) for the read beam only in the form of a
switchable grating unit (50)as claimed in claim 15.

20. An optical head (360) for scanning an information layer (354) and
15 comprising a radiation source unit (362) for supplying a scanning beam
(364,374), an objective system (370) for focusing the scanning beam (374) to
a scanning spot (380) in the information layer and a radiation sensitive
detection unit (384) for converting scanning beam radiation (390) from the
information layer in electrical signals, the radiation source unit emitting at least
20 two scanning beams of different wavelengths for scanning at least two
information planes of different formats, characterized in that it comprises a
beam deflecting element in the form of a switchable phase structure (50) as
claimed in claim 15 to align the axis of the at least two beams having different
wavelengths.

25
21. An optical head (360) for scanning an information layer (354) and
comprising a radiation source unit (362) for supplying a scanning beam
(364,374), an objective system (370) for focusing the scanning beam (374) to
a scanning spot (380) in the information layer and a radiation-sensitive
30 detection unit (384) for converting scanning beam radiation (390) from the
information layer in electrical signals, the radiation source emitting at least two
scanning beams of different wavelengths for scanning at least two information

planes of different formats, characterized in that it comprises a three-spot grating (392) in the form of a switchable phase structure (50) unit as claimed in claim 13.

- 5 22. An optical head (360) for scanning an information layer (354) and comprising a radiation source unit (362) for supplying a scanning beam (364,374), an objective system (370) for converging the scanning beam (374) to a scanning spot (380) in the information layer and a radiation-sensitive detection unit (384) for converting scanning beam radiation (390) from the
 - 10 information layer in electrical signals, the radiation source emitting at least two scanning beams of different wavelengths for scanning at least two information planes of different formats, characterized in that the objective system comprises in addition to a refractive lens system (370) a wavefront-modifying unit (368) in the form of a switchable phase structure unit (50; 200) as claimed
 - 15 in claims 13, 14, 15 or 16.
-
23. An optical head (360) as claimed in claim 22, characterized in that the wavefront-modifying unit (50; 200) is incorporated in the refractive lens system (370).